REMARKS

Claim 1 has been amended and claims 14 and 15 have been added. Claims 1, 2, 4, 5, 7 and 11-15 are pending and claim 13 has been withdrawn from consideration. Claims 1, 11, 12 and 13 are the independent claims. No new matter is presented in this Amendment.

EXAMINER INTERVIEW:

On October 27, 2009 a personal interview was conducted between Examiner Karabi Guharay and Douglas X. Rodriguez (Applicants Representative). During the interview the main reference, Mitanaga, was discussed, and in particular, it was argued that Mitanaga does not show primary and secondary grain boundaries formed perpendicular to each other, since Mitanaga uses an MILS method, whereas the aspects of the present invention use an SLS method. The Examiner contended that although Mitanga did not disclose primary and secondary grain boundaries, such feature was inherent and therefore the reference taught primary and secondary boundaries perpendicular to each other. Finally, the Examiner noted that if Applicants provide evidence that show that the method of Mitanaga does not yield primary grain boundaries perpendicular to secondary grain boundaries, the Examiner would withdraw the rejection.

Accordingly, in order to facilitate prosecution, Applicants have submitted an explanation as to why the MILS method taught by Mitanaga does not form primary and secondary crystal grain boundaries perpendicular to each other and therefore does not teach or suggest the novel features recited in the claims.

REJECTIONS UNDER 35 U.S.C. §102:

Claims 1-2, 5, 7 and 11-12 are rejected under 35 U.S.C. §102(b) as being anticipated by Mitanaga et al. (U.S. Patent 5,923,997).

Regarding the rejection of independent claim 1, it is noted that claim 1 recites a display device with a polysilicon substrate, comprising: a display region; a driving region; a first plurality of thin film transistors, each transistor including a source, gate and drain region, and located in the display region; a second plurality of thin film transistors, each transistor including a source, gate and drain region, and located in the driving region; primary crystal grain boundaries in the polysilicon substrate in the display region and in the driving region; secondary crystal grain

boundaries in the polysilicon substrate in the display region and in the driving region; wherein the primary crystal grain boundaries are located within the gate regions of the first plurality of thin film transistors and are inclined to a first direction of current flowing from source to drain of each of the first plurality of thin film transistors in the display region at an angle of -30° to 30° and the secondary crystal grain boundaries are located within the gate regions of the first plurality of thin film transistors and are inclined to a second direction of current flowing from source to drain of each of the first plurality of thin film transistors in the display region, and wherein the primary crystal grain boundaries are located within the gate regions of the second plurality of thin film transistors and are inclined to the second direction of current flowing from source to drain of each of the second plurality of thin film transistors in the driving region at an angle of 30° to 150° and the secondary crystal grain boundaries are located within the gate regions of the second plurality of thin film transistors and are inclined to the first direction of the current flowing from source to drain of each of the second plurality of thin film transistors in the driving region.

The Examiner relies on Mitanaga for a teaching of the features of independent claim 1. In particular, the Examiner relies on the grain boundaries 216 illustrated in FIGS. 5B and 5C of Mitanaga for a teaching of secondary grain boundaries and states that by definition primary grain boundaries are formed perpendicular to a crystal growth direction. Therefore, the Examiner is of the position that FIG. 5B of Mitanaga illustrates a driving region having primary crystal grain boundaries inclined at an angle of 30° to 150° and secondary grain boundaries inclined to a parallel direction of the current flowing from source to drain of each of the thin film transistors, and that FIG. 5C illustrates a display region having primary crystal grain boundaries inclined at an angle of 330° to 30° and secondary grain boundaries inclined at a direction perpendicular to the current flowing from source to drain of each of the thin film transistors.

Applicants respectfully traverse such assertions for at least the following reasons.

Initially, Applicants note that at least claims 5, 14 and 15 utilize an SLS crystallization method, whereas Mitanaga utilizes a metal induced lateral crystallization (MILC) method. In other words, the SLS method by which the grain boundaries are formed in the recited claims is completely different than the MILC method by which the grain boundaries are formed in Mitanaga.

As illustrated in FIG. 1, noted below, in the SLS crystallization method, when a laser is used, so that amorphous silicon is molten and solidified to be crystallized, a mask pattern is used to irradiate a laser only onto a part of an amorphous silicon layer. As a result, the amorphous silicon layer in which a crystallization seed is not molten is formed. Therefore, when

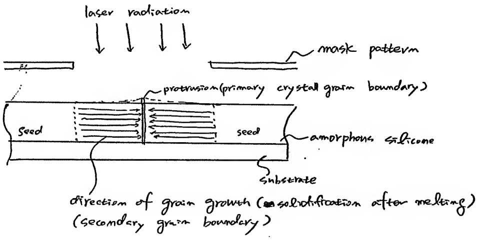
the silicon is solidified after it is molten, crystallization begins from the amorphous silicon, and thus begins in a direction parallel to the substrate.

As described above, as the crystallization proceeds, crystal growth is made in opposite directions, and thus a place where grains meet is formed. A grain boundary is formed at this place. Further, a protrusion is formed at this place, and another grain boundary is formed at this place in the SLS crystallization method (ELA crystallization as well as SLS).

In particular, in the SLS crystallization method, only a part of the silicon is molten using the mask pattern, and thus grain boundaries are inevitably formed perpendicular to a crystal growth direction. These grain boundaries are defined as "primary grain boundaries".

Further, during the crystal growth, grains are grown in a crystal growth direction, and the neighboring grains meet each other, so that grain boundaries are formed parallel to the crystal growth direction. The grain boundaries are parallel to the crystal growth direction, but they are inevitably perpendicular to the above-mentioned "primary grain boundaries."

FIG. 1 illustrates the above described process.



However, the MILC crystallization method of Mitanaga exhibits a different mechanism. Such a mechanism is disclosed in column 2, line 39 - column 3, line 18 of Mitanaga.

That is, as illustrated in the following FIG. 2, in the general MILC (including MIC) crystallization method, the crystallization is made using a metal catalyst for inducing crystallization (in general, Ni is used) as a crystallization seed.

As disclosed in column 2, lines 57 to 64 of Mitanaga, the reference discloses that "it was considered that the temperature of crystallization can be lowered by more positively introducing the crystalline nucleus, and for the purpose of confirming the effect, a bit of other metals was formed on the substrate, and a thin film of the amorphous silicon was then formed thereon." Accordingly, the metal catalyst for inducing crystallization, i.e. the crystallization seed (crystallization nucleus), is formed at an interface between the substrate and the amorphous silicon. Afterwards, when annealing is performed after the seed is formed, grains are grown from the seed. Due to the crystal growth, grain boundaries are finally formed at the places where the grains meet each other.

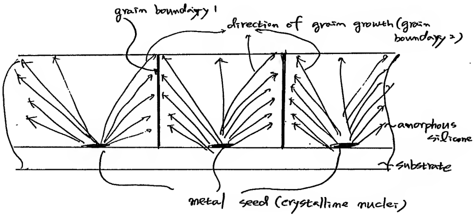
Accordingly, the grain boundary 216 illustrated in FIGS. 5B and 5C of Mitanaga corresponds to a grain boundary 1 illustrated in the following FIG. 2.

Moreover, in the MILC (MIC) method taught by Mitanaga, and as shown below, the grains are grown and finally have a columnar shape.

Therefore, in Mitanaga, two grain boundaries inevitably perpendicular to each other are not formed. As illustrated, in the following FIG. 2, a grain boundary 2 is formed between the neighboring grains. However, the grain boundary 2 is parallel to a crystal growth direction, but is not perpendicular to the grain boundary 1.

The MILC (MIC) crystallization method is a solid-phase crystallization method, and amorphous silicon is not molten during crystallization. As such, the finally formed grain boundary 1 illustrated in FIG. 2 does not protrude.

FIG. 2



Therefore, the SLS crystallization method of the aspects of the present invention is completely different from the MILC (MIC) crystallization method of Mitanaga in terms of crystallization mechanism and the structure formed, and thus the position and size of finally obtained grain boundaries are different in both inventions. Therefore, Applicants respectfully assert that Mitanaga fails to teach or suggest the novel features recited in claim 5, 14 and 15.

Furthermore, since Mitanaga does not disclose that the crystal grain boundaries inherently are always perpendicular to each other when MILC is performed, Mitanaga does inherently disclose the grain directions as recited in independent claim 1.

Accordingly, Applicants respectfully assert that the rejection of independent claim 1 under 35 U.S.C. §102(b) should be withdrawn because Mitanaga fails to teach or suggest each feature of independent claim 1.

Regarding the rejection of independent claims 11 and 12, it is noted that these claims recite some substantially similar features as claim 1. Thus, the rejections of these claims are also traversed for substantially the same reasons set forth above.

Furthermore, Applicants respectfully assert that the rejection of dependent claims 2, 5 and 7 under 35 U.S.C. §102(b) should be withdrawn at least because of their dependency from independent claim 1, and the reasons set forth above, and because the dependent claims include additional features which are not taught or suggested by the prior art.

Therefore, it is respectfully submitted that claims 2, 5 and 7 also distinguish over the prior art.

REJECTIONS UNDER 35 U.S.C. §103:

Claim 4 is rejected under 35 U.S.C. §103(a) as being unpatentable over Mitanaga et al. (U.S. Patent 5,923,997).

Regarding the rejection of claim 4, it is noted that claim 4 depends from independent claim 1, and as noted above, Mitanaga fails to teach or suggest the novel features of independent claim 1.

Accordingly, Applicants respectfully assert that the rejection of dependent claim 4 under 35 U.S.C. §103(a) should be withdrawn at least because of its dependency from claim 1, and because the dependent claim includes additional features which are not taught or suggested by

the prior art. Therefore, it is respectfully submitted that claim 4 also distinguishes over the prior art.

CONCLUSION:

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 503333.

Respectfully submitted,

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